Discussion Paper

on

Key Needs for Agricultural Water Management Research and Training in the Developing Nations

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by

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KEY NEEDS FOR AGRICULTURAL WATER MANAGEMENT RESEARCH AND TRAINING IN THE DEVELOPING NATIONS

1. Unfavorable water environments constitute widespread and critical impediments to the introduction of modern scientific farming techniques in most of the developing nations. The nature and extent of the problems and the need for immediate remedial actions are well documented in several publications.[1,2,3,4,5,6] It would, therefore, serve little purpose to repeat that material. Accordingly, we have limited this paper to a brief summarization of our major conclusions and recommendations.

2. At an early stage in our consideration of this subject we were persuaded that the needs for improved water management were most urgent in the Middle East, South and South-East Asia regions. Hence we focused mainly on the problems of those regions. Political conditions in the Middle East have not been stable during recent months. Hence the field aspect of our study was largely confined to the South and South-East Asia regions.

3. We have endeavored to assess the general nature of the problems and to determine the types of research and training activities that could best aid in improving the efficiency and effectiveness with which water is managed for crop production. We have particularly considered the potential usefulness of a

new international research institute for water management as a means for accelerating improved water use.

CONCLUSIONS AND RECOMMENDATIONS

4. Our investigations indicate that the lack of a basic physical technology is not the most critical bottleneck to significant short-run progress in upgrading the effectiveness with which water is managed for crop production. Sufficient basic technology is available as well as sufficient professional level expertise in each of the required separate scientific disciplines to make significant progress in achieving a more productive use of water in most countries. The critical need in most developing countries is for a greatly enhanced capability to coordinate the application, to field problems, of available technology and expertise in the several scientific specialities involved in the proper use of water for farm production.

5. Our contention that basic physical technology and specialized technical expertise are available to support significant short-run progress, requires brief elaboration. We use the term "basic physical technology" to broadly connote those techniques that can be efficiently researched on a non-location specific basis. Basic physical technology for water management can be broadly categorized as consisting of civil (irrigation) engineering and agricultural science. That classification is admittedly oversimplified, but it is convenient for our present purpose.

6. We have found no substantive evidence that there are major water use problems in the developing countries which are not amenable to solution through applications of known civil engineering principles and techniques. In fact, there are numerous demonstrations of such applications in the Middle East and South-East Asia regions (e.g., Taiwan, Japan, Israel, etc.). Furthermore, many of the developing countries already have a fair to excellent supply of irrigation engineering expertise. We found the technical information and talent more limited in the agricultural science category. But we believe there are a great deal more agricultural technology and expertise available in most countries than are now being effectively utilized. We observed that many of the agricultural scientists lacked practical experience with farming and especially experience with managing modern agricultural systems. There are identifiable gaps in the knowledge of basic soil-water-crop-input-cultural practice relationships. But there are sufficient guidelines to facilitate the testing and adaption programs that always are required to develop locally applicable "packages" of cultivator recommendations for alternative high-yield cropping patterns and agronomic production practices.

7. Policy, administrative, institutional and socio-economic factors often complicate the planning and implementation of programs that involve applications of known and relatively simple principles of physical and biological technology. Those

factors are usually country specific and often have dissimilar consequences in different areas of the same country. One outstanding example of this kind of situation is the widespread inadequacy of minor inter-farm channel systems for conveying water between government irrigation and drainage canals and the individual parcels of land. The design and construction of an efficient system of inter-farm channels is a relatively simple engineering exercise. Considerations of political policy, institutional inflexibilities and socio-economic realities have, up to now, prevented most developing countries from constructing local inter-farm conveyance systems.

8. Unsatisfactory water conditions which will yield only to solutions involving coordinated action by a group of cultivators now limit the production of much of the presently so-called irrigated land of Asia. Very few cultivators have irrigation water supplies under their individual control and/or have land holdings so favorably situated with respect to physical opportunities for water disposal that they could solve their "on farm" water problems through individual independent actions. Improvements in the effectiveness with which water is used will require, most typically, a coordinated attack on both the "on farm" and the "off farm" aspects in each specific irrigation-drainage area.

9. In addition to an integrated consideration of the "off farm" and "on farm" aspects of each area's water problems,

scientific water management must be treated as one component of a multi-component comprehensive program for modernizing agriculture. Such a program should be formulated for each particular hydrologic unit or water problem area. The degree of sophistication used in water management must be consistent with the farming practices of individual cultivators in the area and, through agricultural extension, these practices must be made to match the overall production promise of the hydrologic unit. The lack of balance and coordination between water management programs and the programs for the other phases of agricultural development is a major reason for the current situation in many countries. Very few countries have the organizational and institutional apparatus required to plan, implement and operate agricultural development projects on a fully integrated basis.

10. That agricultural development requires an integrated approach through which all inputs and other requisites are available to cultivators in the proper amounts at the proper times has long been accepted by scientists, planners and policy makers. Much emphasis has been given to the creation of appropriate institutional and physical infrastructures to insure that seed, agricultural chemicals, implements, extension information, markets, etc., were available to cultivators when needed. However, it is only recently that there has been an awareness that water, too, was a manageable input in crop production. Until very recently the tendency was to disregard

or grossly oversimplify the problems of making proper provision for scientific water management in creating the infrastructures for agricultural development.

11. There is now a widespread understanding that the water component can no longer be neglected in planning and implementing farm development. However, most developing countries still lack experience in agricultural development programs with adequate provisions for a quality of water control, at the farm level, which would enable the individual cultivator to handle water in a manner similar to the way he handles other inputs, e.g., fertilizer. In too many countries the planning, construction, and operation of the major structural features for the supply and/or disposal of crop water have not been coordinated with inter-related programs for building the minor inter-farm and even intra-farm irrigation and drainage channels, or with activities that assist farmers in improving their "on farm" techniques to better use available field moisture.

12. Because the physical characteristics of each hydrologic unit are somewhat unique, and because of the interdependent relationships between the physical features of the unit and the socio-economic matrix of the human environment, agricultural development in water problem areas requires an area specific project approach. For these reasons we believe that the small pilot or pioneer project in selected water problem areas is the

most effective vehicle for adaptive research and practical training in water management within the framework of an overall agricultural development program. At this particular stage in the endeavor to improve the effectiveness of water utilization, we consider the pilot project a potentially more useful vehicle than an international research institute of the traditional type. Assisting individual countries to implement such pilot and pioneer projects is, in our opinion, the highest priority activity for improving the effectiveness with which water is utilized in crop production.

13. There are many different concepts about the purpose and scope of a pilot or pioneer project. Our recommendation is based on the concept of a comprehensive program of agricultural development carefully formulated and implemented in portions of an area served by an existing irrigation project. The comprehensive program would include all pertinent aspects of both "off farm" and "on farm" water management integrated with all the other requisites for modernizing agriculture. It is envisaged that a pilot operation would serve as a field-scale laboratory for adaptive research and practical training for:

(a) evolving and testing ways and means of applying existing knowledge to the solution of actual problems;

(b) giving on the job training to all levels of personnel required to get a total job done;

(c) evaluating the practicability and economic feasibility of

alternative approaches to the solution of similar problems;

(d) providing realistic guidelines for estimating the requirements and administrative methods for the implementation of improvements in the total area served by an irrigation project and, by extension, in other similar water problem areas.

14. It is our opinion that several such pilot operations should be undertaken as soon as possible. Each should be mounted in two phases. The initial, or program formulation phase, would include a study of all "off farm" and "on farm" aspects of water management as well as the other factors that are significant in limiting agricultural development throughout the entire irrigation project area. Identification of those portions of the total project facility and service area in which experimental improvements would actually be made would depend upon the conclusions reached in the formulation phase. The magnitude of the pilot operation implemented would be made sufficient to accomplish the four objectives enumerated above.

15. The pilot or pioneer project idea is not new. Several international organizations have supported pilot project activities with water management features for several years. For example, we understand[7] there were 16 UNDP/FAO land and water use projects in the Near East region in May, 1969. Since

its establishment less than four years ago, the Asian Development Bank (ADB) has emphasized assistance in intensifying irrigated agriculture through pilot projects. The ADB recently reported[8] that it was currently funding 16 technical assistance projects in irrigated areas of Asia. Several of these are pilot projects for comprehensive agricultural development that include important water management components. The government of India was recently reported[9] to be sponsoring 10 pilot projects for water management improvement. We were informed that these activities are the result of successful experiences with USAID and Ford Foundation assisted pilot projects which have operated in that country for the past several years. Strong support for initiating pilot and pioneer projects in the present irrigated areas of the Lower Mekong Basin was expressed[10] by the representatives of Laos, Thailand, Cambodia and Vietnam at the seminar for review of the Amplified Basin Plan held in Bangkok November 9-16, 1970. We have also learned that arrangements for several ADB, IBRD, UNDP/FAO assisted pilot-pioneer projects are in advanced planning stages in these states.

16. Many additional examples could be given to justify our conclusions that there is a wide acceptance of the pilot or pioneer project concept among the officials concerned with water management in many developing countries, and that several of the international organizations have had or are gaining considerable experience in assisting these kinds of activities. Indeed, the

ubiquity of such projects leads us to recommend, as the next step, the holding of a seminar to review past experiences and current programs in water use at the farm level as a component in agricultural development. Such a seminar would reveal whether or not there are needs for new types or additional amounts of assistance for pilot and pioneer project activities. Our study also suggests that the seminar should give particular consideration to the establishment of some international or regional mechanism for monitoring and making case studies of certain pilot projects in order to facilitate a wider exchange of information and findings. We propose that such a seminar be scheduled as soon as possible.

17. Our investigations were limited to a preliminary evaluation of the broad ways of providing assistance in research and training on the use of water for farm production. That is, we have not attempted to appraise all of the specific needs of the developing countries for external assistance in farm water management. In the course of our consideration of the broader subject, we have been impressed with the need for further investigations of three specific problems. Our views and suggestions regarding each of these are presented below.

Basic Research in Soil-Water-Crop-Input-Cultural Practices Relationships

18. There are many irrigation projects in both the arid and the humid regions where existing water supplies are not

adequate to provide the full annual irrigation water requirement for all of the commanded land if it is to be cropped at the maximum otherwise permissible intensity. Often, there are physical, economic or other constraints which prevent immediate enhancement of the project water supply. Under these circumstances questions exist about how to maximize the return per unit of available water.

19. In some areas of the humid tropics the questions are further complicated by tremendous water disposal problems because the economic feasibility of providing a high standard of flood control and drainage is uncertain -- at least at the present time. In these areas there is often little basis for determining what degree of partial water disposal improvement by engineering means should be undertaken.

20. For both the excess and the water short conditions there is need for better guidelines for planning cropping patterns and for formulating "packages" of agricultural practices. Our investigations and those reported by others[11,12] indicate that more basic research is needed to define the quantitative relations between the yields of various crops and variations in soil moisture regimes. Moreover, we believe that this kind of research would be an important component of any work on the improvement of upland (rainfed) areas. Accordingly, we recommend that a small team of experts make a general appraisal of the

status of basic research information on soil-water-crop-input-cultural practices relationships for each of the major crops grown in the developing countries. This appraisal should determine if sufficient information is available to broadly determine the response functions for the different crops with variations in soil moisture regimes, and especially the relations between these regimes and the use of other inputs and associated agronomic practices.

21. If that appraisal reveals a lack of essential basic information for any of the important crops and concludes that research programs should be undertaken to obtain this information, we believe such research programs should be undertaken by broadening and strengthening this aspect of the research activities at the appropriate international institutes concerned with crop improvement research.

Institutional Training for Water Management

22. In making our major recommendation regarding pilot and pioneer projects we envisaged these as important vehicles for "on-the-job" training of water technologists. In addition to these, however, we believe that many developing countries will need to expand their university and sub-professional training programs in water management. We have not investigated this matter in detail, but it is our impression that there are large needs for additional trained manpower (from postgraduate to

technician) in all the aspects of water management which involve the disciplines of agricultural science. A related problem of importance is the training of civil engineers in the broad fundamentals of agriculture. Although training programs of these kinds are most appropriately a national responsibility, we think there may be an important potential for special regional acitivities for the training of teachers. Accordingly, we recommend that the problems of professional and vocational training for agricultural water management be investigated by a special task force.

Groundwater Technology

23. The use of groundwater resources has contributed significantly to recent spectacular increases in cereal production in a few countries. Individually and small group owned or controlled water sources do not involve as many organizational and administrative complexities as large surface water projects. For these reasons there is wide interest in accelerated groundwater utilization in many developing countries. Groundwater and surface water development and use should be planned on a conjunctive basis by hydrologic units. However, many countries lack sufficient information about their groundwater potentials to permit the use of that approach. Moreover, not many countries have sufficient expertise in modern groundwater technology (geology, hydrology and allied specialities) to guide the high priority resource inventory and development activities

which should be parts of their present water development and utilization programs. We believe these deficiencies deserve special investigation by a team of experts.

SUMMARY OF RECOMMENDATIONS

24. We have recommended that:

A. The implementation of pilot models of comprehensive agricultural development in portions of existing irrigation-drainage project areas be emphasized for adaptive research and practical training in agricultural water management.

B. A seminar be held, as soon as possible, at which the pilot project experiences and programs of international organizations would be reviewed and the potential usefulness of new international or regional mechanisms for pilot project assistance would be explored.

C. Investigations be made by separate expert task forces to determine the needs for additional;

(a) basic research on soil-water-crop-input-cultural practices relationships at crop-oriented international research institutes;

(b) assistance with institutional training in the agricultural aspects of water management;

(c) assistance with the acceleration of assessments of groundwater resources and with training in modern groundwater development techniques.

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